APPROXIMATE ELLIPTIC ELEMENTS OF COMET, 1884*b*.

By W. H. Finlay, B.A., F.R.A.S.

It was soon found by myself and astronomers in Europe that a parabolic orbit would not satisfy the observations of this comet. I determined therefore to try and deduce an elliptic orbit. As my own observations were the only ones available at the time I did not attempt more than a fairly close approximation, and for that purpose chose the observations of July 27, August 22, and September 17: the observations on these nights were noted as "good," and they were nearly equidistant. From them I derived the following elements:—

		d.			
Perihelion passage	..	Aug. 16·5095			Greenwich mean time.
π	..	306	3	30	Mean Equinox and Ecliptic 1884·0
A	..	4	54	1	
ι	..	5	30	36	
log. a	..	0·5017524			
log. μ	..	2·7973780			
ρ	..	36° 34′ 31″			
Period	..	5·6615 years.			

The comet, therefore, belongs to the class of short-period comets, of which we have about a dozen instances. At its nearest approach to the sun it is about midway between the orbits of the earth and Mars, and at its furthest distance it almost reaches the orbit of Jupiter. Like others of its class it has probably been diverted from its original path in space by the attraction of Jupiter, and forced to become a member of the solar system. The elements, with the exception of the Node, show a strong resemblance to de Vico's comet of 1844, for which a period of 5½ years was found, but which has never been seen since.

METEOROLOGICAL NOTES.

By John G. Gamble, M.A.

[Read 1884, Dec. 4.]

I. The Monthly Averages of the Daily Readings of the Maximum and Minimum Thermometers.

Nearly four years ago I read a paper before this Society on summer and winter temperature in South Africa. Since then the observations have improved both in quantity and quality, the latter being mainly owing to the annual inspection by the Secretary.

I have now calculated the monthly averages of the daily readings of the maximum and minimum thermometers. These tables have been printed in the Colonial Blue Book [and therefore are not again reprinted here.] In order, however, to make the statistics more interesting and useful, I have prepared twelve maps giving the maximum and minimum isothermals for each month in the year, and forty-two diagrams showing the annual march of maximum and minimum temperature at each of the twenty-one selected stations. I do not ask the

Society to engrave these as in a few years time more accurate ones can be drawn.

The Colonial observations are those given in the reports of the Meteorological Commission, except in the case of Graham's Town, where a series of five years' observations, carefully taken some years ago by the Royal Engineers, was preferred. The Maritzburg observations have been published by Dr. R. Mann, and th se at Durban, Natal, are from sheets printed in Natal.

Mean temperature is roughly speaking about one degree less than the half sum of the maximum and minimum. Until we can get hourly readings from some up-country station, perhaps this is the most trustworthy way of getting mean temperature that is available.

The periods are not simultaneous; had only simultaneous registers been chosen, some very valuable registers would have been omitted, for example, that kept at Worcester by Mr. Hugo, now C.C. of Aliwal North, for the ten years 1862-1871.

Of late years Stevenson cribs have been used everywhere, but formerly there was no uniformity of exposure. The importance of attending to exposure was well shown by Dr. Gill in a paper read before the Royal Meteorological Society. At the Royal Observatory one set of thermometers have for many years been kept in a window crib, another set have recently been placed in a Stevenson screen. The mean maximum in the window is more than three degrees lower than the mean maximum in the Stevenson, while the minimum in the window is nearly three degrees higher.

With unpaid observers the maximum and minimum are convenient, as there is no absolute need to read them exactly at the same hour every day, and for most purposes of animal or vegetable life we wish to know the extremes rather than the temperature at any fixed time.

The maps and diagrams are very suggestive. For example, the small mean monthly range (12°) at coast places, the large range (often over 30°) at inland places. Dry places also like Clanwilliam and Nel's Poort have hot days and cool nights. Simon's Town, Mossel Bay, Port Elizabeth, East London, and Durban have all comparatively warm nights. This is partly due to the blanket-action of watery-vapour preventing the radiation of dark heat from the earth, partly to the Mozambique or L'Agulhas current, the temperature of the sea being never less than 70° off Durban and over 76° in summer.

It will be seen that the summer afternoons at Maritzburg are not so hot as in our Western and inland districts; and Mossel Bay, Port Elizabeth, and East London have cooler summer afternoons than Wynberg or Cape Town, the reason being that in the extreme West the summer is the dry time, while in the East summer is rainy, and along the south coast there is some rain at all seasons.

The coldness of the winter nights up-country is mainly due to the considerable height above sea-level—radiation into space going on unchecked.

It is well known that the maximum always reads less on a mountain than on the plain below, but this is not the case with the minimum. The night temperature is sometimes colder on the plain than on the mountain, as has been found in comparing the readings taken on Table Mountain with those taken at the Royal Observatory.

The difference between the hottest and coldest years is greater inland than on the coast.

	max.	min.
At Aliwal North ..	7·5	8·1
Port Elizabeth ..	2·9	3·2
Royal Observatory	3·2	3·5
Worcester ..	2·6	3·0

A curious feature is a hesitation in the annual curve of temperature, both at Maritzburg and Durban, in October and November. This is probably owing to the commencement of the rainy season.

Inland places get their maximum and minimum temperatures earlier than coast places, the latter having what is called a retarded climate; this is seen in the diagrams.

II. Barometric Observations at the Cape.

Simultaneous readings of the barometer at 8 a.m. have for some time past been taken at several points along the coast, and telegraphed to the Secretary of the Meteorological Commission, who reduces them to a uniform temperature of mercury, and to what they would have read at sea-level, thus rendering comparisons between them possible, and giving us some idea of which way the barometric gradient runs.

The question is frequently put, Why do you not include up-country stations? The reply is that we do not know the law of reduction to sea-level. In European weather-charts, places more than a few hundred feet above sea-level are omitted. The formula of Laplace, amended by Bessel and others, applies fairly well to mountains near the coast, but does not apply to elevated table-lands, as has been shewn of the simultaneous observations taken at Clermont and on the Pûy de Dome. The reduction used for low levels cannot be satisfactorily applied to great heights, and if applied has no physical meaning.

Until the organization of an annual inspection by the Secretary, the up-country barometric observations were generally untrustworthy. I would except Mr. Hugo's observations at Worcester, and one or two others. To show this, it may be mentioned that when the railway reached King William's Town, the level of the hospital was connected with the rail-level, and found to be 1314 feet above sea. But we had previously supposed from comparison of barometer readings that it was 1647! On examination it was found that the hospital barometer had air in it. A similar experience was made at Colesberg bridge.

In finding heights by barometric readings, it is most important that both summer and winter observations should be taken, as the daily and annual variations of pressure at sea-level are not at all the same as those at five thousand and more feet above the sea. Some years ago I made a long journey in the Colony in an ox-wagon, and I took a travelling mercurial, which I slung and "guyed" to the roof of the wagon. This journey was in summer time, and I have reason to believe that most of the heights I then calculated are too high. On the occasion of a subsequent journey in winter time I made the heights of places too low.

As a test of what may be the errors of barometic measurement of heights, the following examples are interesting. The town of Colesberg is found by railway levelling to be 4407 feet above the sea. The botanist, Drège, a very careful observer, is less than one per cent. wrong, he having made it 4430, but this, no doubt, was somewhat fortuitous. Wyley, the geologist, made it five per cent. too low, 4200.

Dr. H. Leach, whose heights are all much too high is in this case seven per cent. out, 4700. The readings of the mercurial barometer, carried by the Secretary of the Meteorological Commission on one of his inspections, gave 4023 or nine per cent. too low.

The private meteorological observatory at *Aliwal North* is 4330 above sea level by spirit-levelling. By comparing the mean barometric readings of the years 1877, 1878, 1879, with the mean at Port Elizabeth for the same time, I make 4375 or one per cent. too high. By comparing '77 only with the Royal Observatory, I make 4326, '78, 4337, '79, 4368, '80, 4334, which are remarkably close.

The height of Pretoria is given somewhat variously:

Dr. Leach	4620
Jeppe	4450
Serpa Pinto	4298
A. Anderson	4090
Baines	4007

As also is Lydenburg:

Baines	5825
Erskine	4781
Cohen	4706
Sir Chas Warren	4350

I think we may say that simultaneous barometric readings continued for a year with all proper precautions should give the height within two per cent. When however heights are got from a single observation or even from several observations taken much about the same time, an error of ten per cent. may be expected.

The great uncertainty of the air-temperature is the great drawback to accurate work. The correction is a rather large one, the factor being $\frac{t_1 + t_2 - 64.}{900.}$

Curves showing the fluctuation of pressure in the yearly period have been drawn for three coast stations, Royal Observatory, Mossel Bay and Port Elizabeth, and for five up-country stations, Worcester, Lovedale, Aliwal North, Bloemfontein and Sutherland. [The tables from which the diagrams were drawn are given below].

All the averages are, of course, corrected for temperature of mercury, but only the observations taken close to the sea are reduced to sea-level for reasons given above.

The early appearance of the maxima and minima for the year at the up-country stations is noteworthy, pressure agreeing with the temperature in this peculiarity.

There is at most stations a very remarkable hesitation or bend in the month of May. At some stations this is not so clear, and this is the case at the Royal Observatory. I believe this depression is a true feature, and that the reason why it is not shown in the Royal Observatory's diagram is that the periodic minimum frequently occurs there in the beginning of June instead of at the end of May, thus masking or smoothing out the depression when the curve is only drawn from monthly averages. I am in the hope of being able to get out five day means for some places, which will no doubt throw light on the question. It seems probable that this May depression is analogous to the well-known "November wave," of the northern hemisphere, and perhaps also to the short period of unusually mild weather generally experienced before the beginning of winter, and called "the Indian" or St. Martin's summer.

Monthly Averages for three Coast Stations reduced to 32° F., to Sea-level, and to Kew Standard.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Royal Obervatory, 40 years obs. ..	29·949	29·947	29·989	30·045	30·085	30·152	30·184	30·156	30·123	30·063	30·012	29·975	30·057
Mossel Bay, 7 years	29·942	29·965	30·012	30·052	30·047	30·163	30·151	30·170	30·122	30·055	30·012	29·975	30·055
Port Elizabeth, 16 years	29·963	29·987	30·026	30·082	30·070	30 177	30·180	30·151	30·144	30·079	30·032	29·976	30·072

Monthly Averages for Five Up-country Stations reduced to 32° F., but not to Sea-level.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Worcester, 7 years, 776 ft. above sea level	29·145	29·140	29·206	29·223	29·242	29·302	29·340	29·341	29·307	29·231	29·217	29·156	29·238
Lovedale, 5 years, 1,800 ft. above sea level	28·154	28·190	28·249	28·287	28·288	28·445	28·387	28·367	28·304	28·253	28·210	28·164	28·275
Aliwal N., 7 years, 4,330 ft. above sea level	25·619	25·652	25·702	25·747	25·763	25·866	25·845	25·806	25·755	25·683	25·630	25·602	25·722
Bloemfontein, 5¾ years, 4,500 ft. above sea level ..	25·473	25·505	25·536	25·598	25·612	25·706	25·689	25·640	25·600	25·532	25·480	25·471	25·570
Sutherland, 4½ years, 4,777 ft. above sea level	25·251	25·257	25·290	25·318	25·321	25·437	25·428	25·406	25·348	25·310	25·257	25·241	25·322